# REPORT OF SERVICE TESTS

on

# CONCRETE FLOOR TREATMENTS.

-0-

Bureau of Standards,

Washington, D. C.

Oct. 28, 1920.

## Purpose of Tests.

Numerous inquiries for information concerning the relative merits of various concrete floor treatments have led to a comparative study of several proprietary treatments and a few "home treatments". The investigation has been based mainly upon observations of treated concrete floor panels under actual service conditions, and, therefore, the results are not quantitative or necessarily conclusive, but are in general indicative of what may be expected of the various treatments when exposed to such conditions for the stated periods of use. Pending the development of a suitable apparatus for making quantitative wear tests, it is believed that the knowledge gained from this study will be of considerable value since it shows the behavior of the treatments placed side by side under as nearly the same traffic conditions as could be obtained for a test of this kind.

## Description of Tests.

The materials were applied to the slabs in the corridors of the Northwest Building of the Bureau of Standards, which is used for laboratory purposes and was completed in March, 1918. The building was occupied shortly after this time and very soon the floors began to dust and crumble at the surface. Hence, it may be said that these floors offered an excellent opportunity for determining the merits of such treatments. The first materials were applied about five months after the floors were completed and other treatments were applied during the following six months. With one exception, applications were made by men from the laboratory force, careful attention being given to the directions furnished by the manufacturers. The exception was a treatment which required a special apparatus and was applied by the producer.

The sections of the floor which are referred to as panels are eight feet square, i.e., they extend the width of the corridor and eight feet along its length. The traffic on the different panels is similar, but since the entrance is at the center, it is evident that the panels near the entrance are subjected to more use than those near the ends. With the exception of the fact that laboratory machines and office fixtures are occasionally moved over the floors, the panels are subjected only to light foot traffic.

The effect of the traffic was studied in comparison with panels which were left untreated. The determination of the wear is based on careful observations. The relative hardness was measured roughly by the resistance of the surface to scratching with a steel pointed tool.

## Materials.

The materials included in these tests are given in the following list. The proprietary materials were in most cases submitted by the manufacturers, and the others were prepared in the laboratory according to formulae which have been recommended.

### Proprietary Materials.

| Trade Names | Manufacturers. |
|---|---|
| Vitrogen | The Arco Co., Cleveland, Ohio. |
| Flintox | Toch Bros., New York City. |
| Acid Proof Filler | Toch Bros., New York City. |
| Cement Filler | Toch Bros., New York City. |
| Lapidolith | L. Sonneborn Co., New York City. |
| Crystalrox | General Fireproofing Co., Youngstown, Ohio |
| Saniseal | Master Builders Co., Cleveland, Ohio. |
| Colorseal | Master Builders Co., Cleveland, Ohio. |
| Magnesium Fluosilicate | U. S. Lead Refinery Co., East Chicago, Ind. |
| Indurite | Ceresit Waterproofing Co., Chicago, Ill. |
| Liquid Concrex | A. C. Horn, Long Island City, N. Y. |
| Esco | Preservative Products Co., New York. |
| Bilchaco | Billings Chapin Co., Cleveland, Ohio. |
| Concreto | Murphy Varnish Co., Newark, N. J. |
| Minwax | Minwax Co., New York City. |
| Thermowax | The Thermowax Co., Dallas, Texas. |
| Saum's Preservative | The Sagendorph Co., Philadelphia, Pa. |

### Home Treatments.

Sodium Silicate
Aluminum Sulphate
Linseed Oil
Fuel Oil and Soap
Soap Treatment

In order to avoid difficulties arising from the direct reference by trade names the materials and tests are described under reference letters.

## Results of Tests.

Treatment A.

This treatment consisted of a 15% solution of magnesium fluosilicate applied in three coats diluted as follows: 1st., one part solution to two parts water; 2nd., one part solution, one part water; 3rd., two parts solution to one part water.

The panel has been in service two years and three months. The surface is quite hard and shows no wear except on a few small areas, which are rather soft and can be readily scratched. It appears that these areas were originally the high places and did not receive the proper amount of the treatment.

Treatment B.

This material was also a solution of magnesium fluosilicate approximately 8.7% in strength. It was applied in three coats diluted in the same way as material A regardless of the weaker solution.

This treatment was applied six months later than the above and has been in use one year and nine months. The panel shows considerable wear and is scractched in many places due to moving materials over it. It seems probable that the solution was too weak and did not afford the proper amount of the hardening element.

Treatment C.

This was a 14.5% solution of magnesium fluosilicate. Instead of being applied as the other materials of this type, it was applied copiously in one coat without dilution.

This panel has been in service two years and two months. It is in good condition and uniform in appearance. No wear is apparent.

Treatment D.

This treatment consisted of a 11.5% solution of magnesium fluosilicate applied in three coats diluted as material A. The panel has been in service one year and eight months. It shows no definite signs of wear and is uniform in appearance.

Treatment E.

This treatment consisted of a solution of magnesium fluosilicate approximately 18% in strength containing a small amount of zinc fluosilicate. It was applied in three coats diluted like material A.

This panel was very poor before the treatment was applied, i.e., it was crumbling badly at the surface. It was hardened to such an extent that no appreciable wear has occurred since the treatment was applied. It has been in service two years.

Treatment F.

This material consisted of a solution of magnesium fluosilicate approximately 7.3% in strength, containing 2.6% magnesium sulphate and 4.5% of free hydro-fluosilicic acid. It was applied in three coats diluted like material A.

The panel has been in use one year and eleven months. It shows considerable wear and the surface can be easily scratched.

Treatment G.

This was a 16% solution of zinc sulphate with about 4.5% free sulphuric acid. It was applied without dilution in two coats. After the first treatment had dried for four hours, the surface was scrubbed with hot water and mopped dry when the second was applied.

This panel has been in service two years and three months. The surface is very hard and uniform. No signs of wear are apparent. The treatment gives a darker appearance than the original concrete.

Treatment H.

This treatment consists of a 20% solution of sodium silicate containing a small addition of an organic acid. It was applied without dilution in two coats 24 hours apart. The slab was covered with a bridge of plank until dry.

This panel has been in service two years and two months, and shows no signs of wear. The surface is hard and uniform. The treatment gives a brighter and more uniform appearance than the original.

Treatment I.

This is a home treatment consisting of an 8% solution of commercial sodium silicate applied in three coats. Each treatment was preceded by a thorough scrubbing of the surface with water.

The panel has been in service two years and two months. The surface is very hard and shows no signs of wear. The treatment gives a uniform appearance which is lighter than the original.

Treatment J.

This treatment consisted of a 15% solution of aluminum sulphate applied in three coats which were dilutions of the original solution as follows: 1st., one part solution to two parts water; 2nd., one part water to one part solution; 3rd., two parts solution to one part water. The treatment was applied liberally with a whitewash brush at intervals of 24 hours.

This treatment was applied to several panels in the corridor and to the floor of one large laboratory room where it was necessary to keep the dust down on account of the machinery. The treatment has been in use one year and six months and has proved quite satisfactory. The surface is not quite so hard as was obtained by some of the other treatments but it has been effective in holding the dust. This is a very economical home treatment which can be easily applied without interfering with the traffic.

Treatment K.

This was a gray paint consisting of a pigment of basic lead sulphate, siliceous matter, and carbon in a tung oil rosin varnish vehicle (mineral spirits thinner). The surface was thoroughly cleaned by sweeping and the paint applied in two coats 24 hours apart. The surface was covered with a bridge of plank until thoroughly dry.

This panel has been in service two years and two months. The coating is showing the effects of wear at the parts most used. While the paint is not worn entirely through, the lighter color at these places give the floor a lack of uniformity in appearance.

Treatment L.

This material was a china wood oil varnish, which was applied in two coats 24 hours apart. The floor was dry cleaned

as for treatment K and kept covered with a bridge of plank until dry.

The slab has been in service for two years and one month. The surface has a few scratches due to moving machinery over it and is slightly lighter in color where most used which shows that the coat is wearing thin at these places.

Treatment M.

This was also a china wood oil varnish applied in two coats at an interval of 24 hours, and kept covered with the bridge of plank until dry.

The panel has been in service two years and two months and shows no appreciable signs of wear.

Treatment N.

The material consisted of a thin bodied mineral spirits varnish applied in two coats at an interval of 24 hours and kept covered with a bridge of plank until dry.

The panel has been in service two years and one month. The coating seems to be worn through where most used as shown by the lighter color at these places. This panel was originally weak and crumbling badly and hence the test was quite severe.

Treatment O.

This was a gray paint with a pigment of basic lead sulphate, zinc oxide, barium sulphate, siliceous matter, and carbon in a linseed oil, rosin (and probably some tungoil) vehicle, having a mineral spirits thinner. After the panel was swept clean the first application was thinned with a material called the reducer, which was of the nature of a thin bodied varnish. After 24 hours a coat of the paint was applied without the thinner. Each coat was covered with a bridge of plank until dry.

This panel has been in service one year and five months, and shows no signs of wear except a few scratches which were probably caused by moving machinery over it. The treatment gives a wax-like surface which is not especially resistant to scratching but seems to be reasonably durable under foot traffic.

Treatment P.

This was a very thick paint consisting of a pigment of zinc oxide, lithophone and bone black in a varnish vehicle

containing rosin. It was applied in one coat after the floor had been thoroughly swept. The one gallon sample received for this test was only sufficient to cover the 64 sq. ft. The directions required two applications but the one gave a thick elastic coat which was considered sufficient for the purpose in view.

This treatment has been in service one year and six months. It shows several large scratches due to moving machinery over it and a few small spots have blistered and worn away. The thick film obtained with this material is very pleasing to walk upon but has not proved durable under the conditions to which it has been subjected. It is believed that a preliminary roughening of the concrete would avoid blistering, and give a coating that would be satisfactory for office purposes.

Treatment Q.

This treatment consisted of a solution of heavy hydro-carbon wax in a light hydro-carbon oil applied to the surface in two coats 24 hours apart.

The panel has been in service two years and three months and shows considerable wear. The object of this treatment is only to hold the dust and no claims are made as to hardening the surface.

Treatment R.

This treatment consisted of a mixture of waxes applied to the floor in a molten condition. It was applied in sections which were heated with a special apparatus before and after the application. The object of this treatment is similar to that of Material Q. More wax is left on the surface which acts as a binder to loose particles. One panel and one office room were treated with this material. Both show considerable wear. Under the office chairs the treatment seems to be worn through. This has been in service two years and four months.

Treatment S.

This treatment consisted mainly of linseed oil with a small addition of citronella. It was applied in one coat and kept covered until dry.

While this panel has not proven entirely satisfactory, it appears to be harder at this time than it was one year ago. The panel probably should have had two applications instead of one. The directions advised one coat for new floors and two coats for old badly worn floors. The appearance obtained was not uniform which indicates that the proper amount of the treatment was not applied and hence it is believed that little weight should be given the test.

Treatment T.

This treatment consisted of four applications of raw linseed oil thinned with turpentine.

It has been in service two years and two months. The results obtained at first were not satisfactory but the surface appeared to harden gradually until at present it is quite hard. It appears to be resisting the wear very well.

Treatment U.

This treatment and the one following are what might be called janitor processes. It has been noticed that concrete floors under actual use sometimes take on a polish or present a wax-like appearance. In order to determine if this condition was due to the precipitation of soap in the concrete, some sections of the floor were frequently scrubbed with a thick soap solution. The polished condition did not occur in this case which was believed to be due to the fact that the floor was very porous and hence the solid matter from the treatment was not retained in the concrete.

Treatment V.

This treatment was an emulsion of fuel oil and soap in the proportion of three quarts of oil, two bars of ivory soap and four gallons of water. This treatment was not included in the series described above but was applied recently in the corridors of another building, the floors of which were originally much better than those described. The emulsion was applied with a mop at intervals of a week or two. About ten applications were made and the floors were greatly improved. They do not appear to be dusting and the surface is somewhat harder than the original. This application leaves the floor slippery for a few hours.

## Conclusions.

1. The above-described experience with materials of the magnesium fluosilicate class indicates that very good results may be obtained by such treatments but that there is a need for more knowledge concerning the proper strength of solution and method of application.

2. The zinc sulphate treatment has given excellent results.

3. The surface coating materials are most effective in entirely eliminating the dust. The length of service that can be obtained from this type will usually be limited to a year or two depending on the nature of the traffic, but since the greater portion of the floor does not usually receive a large amount of wear, the worn places may be resurfaced at a small expense.

4. Two home treatments, viz., I and J, have proven very successful and are quite inexpensive to apply. The following instructions are given for the use of the home treatments:

A. Sodium Silicate Treatment.

Commercial sodium silicate usually varies in strength from 30 to 40 per cent solution. It is quite viscous and has to be thinned with water before it will penetrate the floor. In ordinary cases it will be found satisfactory to dilute each gallon of the silicate with four gallons of water. The resulting five gallons may be expected to cover 1000 sq. ft. of floor surface, one coat. However, the porosity of floors varies greatly and the above statement is given as an approximate value for estimating purposes.

The floor surface should be prepared for the treatment by cleaning free from grease, spots, plaster, etc., and then thoroughly scrubbed with clear water. To get the best penetration the floor should be thoroughly dry, especially before the first application, and if practical it is well to let it dry for several days after the first scrubbing. The solution should be made up immediately before using. It may be applied with a mop or hair broom and should be continuously brushed over the surface for several minutes to obtain an even penetration. An interval of 24 hours should be allowed for the treatment to harden after which the surface is scrubbed with clear water and allowed to dry for the second application. Three applications made in this manner will usually suffice but if the floor does not appear to be saturated by the third application a fourth should be applied.

This treatment when properly applied gives a very hard surface that is bright and uniform in appearance. The commercial sodium silicate can be obtained from wholesale druggists usually at a cost of 40¢ or less per gallon.

B. Aluminum Sulphate Treatment.

The solution of aluminum sulphate for this treatment should be made in a wooden barrel or stoneware vessel. The amount required may be estimated on the basis of one gallon of solution for each 100 square feet of area. For each gallon of water 2½ lb. of the powdered sulphate will be required. The water should be acidulated with commercial sulphuric acid by adding 2 cc. of the acid for each gallon. The sulphate does not dissolve readily and has to be stirred occasionally for a period of a few days, until the solution is complete.

The floor should be cleaned of grease spots, plaster, etc., then thoroughly scrubbed. When the surface is entirely dry, a portion of the sulphate solution may be diluted with twice its volume of water and applied with a mop or hair broom. After 24 hours dilute a portion of the original solution with an equal volume of water and apply in the same manner as the first. Allow another

interval of 24 hours and make an application using two parts of the sulphate solution to one part of water. Each application should be continually brushed over the surface for several minutes to secure a uniform penetration. After the third application has dried, the surface should be scrubbed with hot water.

This treatment will give good results at a cost about equal to that of the sodium silicate treatment.